света. При использовании такого подхода невозможно по спектрам рассеяния идентифицировать сложную исследуемую мишень - сложные биомолекулы и наносистемы.

В данной же статье рассмотрена теория рассеяния ультракоротких мощных лазерных импульсов аттосекундной длительности сложными наносистемами [1-3]. Разработаны методы расчетов процессов рассеяния, угловых распределений и спектров рассеяния лазерных импульсов аттосекундной длительности сложными трехмерными системами с учетом их дефектов.

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## STUDY OF THE ELECTRONIC STRUCTURE OF THE TOPOLOGICAL INSULATOR $Bi_{1.1}Sb_{0.9}Te_2S$

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The surface and bulk electronic band structures of $Bi_{1.1}Sb_{0.9}Te_2S$ topological insulator were studied by angle-resolved photoelectron spectroscopy (ARPES) and Far- and Mid-infrared spectroscopy.

$Bi_{1.1}Sb_{0.9}Te_2S$ is attractive as a material belonging to the class of so-called topological insulators (TIs). TIs have a bulk band gap like an ordinary insulator but on the surface strong spin-orbit coupling produces topologically protected surface states [1]. In addition to the fundamental interest, these states could be useful for spintronics [2] and quantum electronics [3].

In this work the surface and bulk electronic band structures of $Bi_{1.1}Sb_{0.9}Te_2S$ single crystals were studied by ARPES and Far- and Mid-infrared spectroscopy. ARPES measurements were performed at 20 K using He lamp (hv = 21.2 eV). The reflectivity

and transmission measurements were carried out over the frequency range from 0 to 5000 $cm^{-1}$ at 4.2 K.

ARPES measurements demonstrated clear Dirac-type dispersion of the surface states with its Dirac point at a binding energy of about $E_B$ = 230 meV. The transmission spectra revealed absorption band edge at 2528 $cm^{-1}$ (suggesting a band gap of $E_g$ = 0.313 eV at 4.2 K) and free carrier Drude edges at 228 $cm^{-1}$ as well as strong Fabry-Perot oscillations. The reflectivity spectra showed the Drude edge at 256 $cm^{-1}$ and two phonon related features at 51 and 151 $cm^{-1}$. The asymmetric shape of phonon related features at 51 $cm^{-1}$ suggest its relation to electron-phonon coupling and Fano physics. The middle point of the Drude edge in the reflectivity spectrum corresponds to the minimum in the transmission at 225 $cm^{-1}$.

The observed peculiarities demonstrate the intrinsic complexity of the studied material. Further investigation of topological effects requires the application of magneto-optical spectroscopy methods.

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## LUMINESCENCE STUDY OF $KLuP_2O_7$ DOPED WITH $Pr^{3+}$ IONS UNDER DIFFERENT TYPES OF EXCITATION

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This paper reports the spectroscopic properties of praseodymium-doped potassium lutetium double phosphates, $KLuP_2O_7:Pr^{3+}$(1%). Spectra of photoluminescence (PL), PL excitation, X-ray excited luminescence and pulse cathodoluminescence, thermally stimulated luminescence were measured.

Praseodymium-ions doped luminescent materials are recently being actively investigated due to demonstration of fast interconfigurational 5d – 4f optical transitions. The application of such materials is rather perspective in medical and detectors fields. Many detecting materials are doped with $Ce^{3+}$ ions. Praseodymium emission in comparison with cerium ions is located in higher energy region and is characterized with shorter lifetime (about 20 instead of 30 ns). The search of new scintillating materials is very actual problem of modern investigation researches. The study of $KLuP_2O_7$ doped with $Pr^{3+}$ began in works [1, 2].

Results of spectroscopic properties investigation are presented in this paper. The complex of spectroscopic methods was applied. Measurements of objects were done applying different techniques. Spectra of photoluminescence (PL) upon UV-VUV excitation, PL excitation spectra as well as spectra of X-ray excited luminescence (XRL)